

# **MINIDISK USERS MANUAL**

**VME/10  
Microcomputer System  
Winchester Disk Drive  
User's Manual**



***MICROSYSTEMS***

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JANUARY 1984

VME/10  
MICROCOMPUTER SYSTEM  
WINCHESTER DISK DRIVE  
USER'S MANUAL

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WARNING

THIS EQUIPMENT GENERATES, USES, AND CAN RADIATE RADIO FREQUENCY ENERGY. THIS EQUIPMENT HAS BEEN TESTED AS A CLASS A COMPUTING DEVICE AND HAS BEEN FOUND TO COMPLY WITH PART 15 OF FCC RULES. HOWEVER, OPERATION OF THIS EQUIPMENT MAY CAUSE INTERFERENCE, IN WHICH CASE THE USER, AT HIS OWN EXPENSE, WILL BE REQUIRED TO TAKE WHATEVER MEASURES MAY BE REQUIRED TO CORRECT THE INTERFERENCE.

First Edition

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## **SAFETY SUMMARY**

### **SAFETY DEPENDS ON YOU**

*The following general safety precautions must be observed during all phases of operation, service, and repair of this equipment. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the equipment. Motorola Inc. assumes no liability for the customer's failure to comply with these requirements. The safety precautions listed below represent warnings of certain dangers of which we are aware. You, as the user of the product, should follow these warnings and all other safety precautions necessary for the safe operation of the equipment in your operating environment.*

#### **GROUND THE INSTRUMENT.**

To minimize shock hazard, the equipment chassis and enclosure must be connected to an electrical ground. The equipment is supplied with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter, with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

#### **DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.**

Do not operate the equipment in the presence of flammable gases or fumes. Operation of any electrical equipment in such an environment constitutes a definite safety hazard.

#### **KEEP AWAY FROM LIVE CIRCUITS.**

Operating personnel must not remove equipment covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

#### **DO NOT SERVICE OR ADJUST ALONE.**

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

#### **USE CAUTION WHEN EXPOSING OR HANDLING THE CRT.**

Breakage of the Cathode-Ray Tube (CRT) causes a high-velocity scattering of glass fragments (implosion). To prevent CRT implosion, avoid rough handling or jarring of the equipment. Handling of the CRT should be done only by qualified maintenance personnel using approved safety mask and gloves.

#### **DO NOT SUBSTITUTE PARTS OR MODIFY EQUIPMENT.**

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification of the equipment. Contact Motorola Microsystems Warranty and Repair for service and repair to ensure that safety features are maintained.

#### **DANGEROUS PROCEDURE WARNINGS.**

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed. You should also employ all other safety precautions which you deem necessary for the operation of the equipment in your operating environment.

#### **WARNING**

**Dangerous voltages, capable of causing death, are present in this equipment. Use extreme caution when handling, testing, and adjusting.**

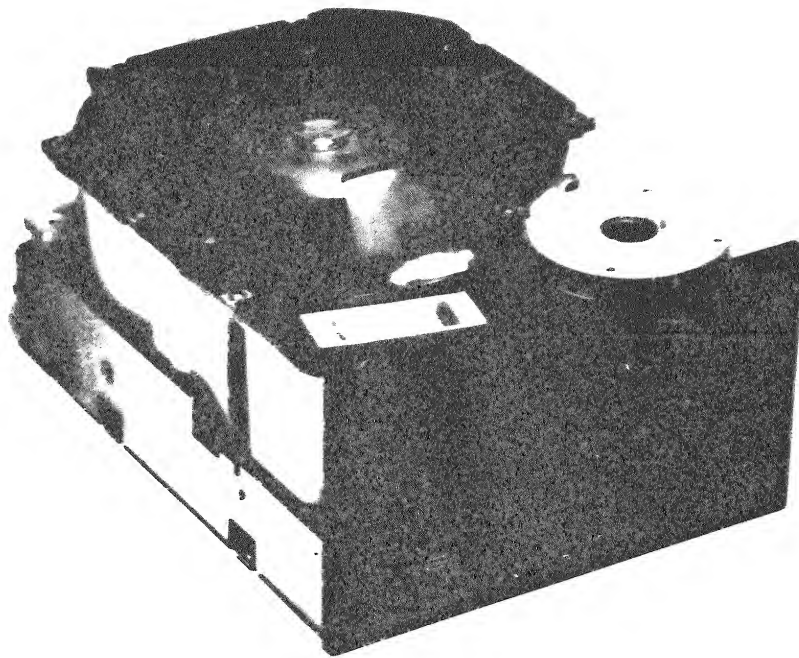


## PREFACE

This manual contains the Computer Memories, Incorporated, CM5000 5-1/4" Series Winchester Disk Drive OEM Manual, P/N 200917-01. Also included are errata sheets correcting this manual.

Permission to reprint this manual has been granted by Computer Memories, Incorporated.

Refer to the VME/10 Microcomputer System Equipment Manual, publication number M68KVSEM, for all external signal and power wiring information to the Winchester disk drive.



CM 5000 5 1/4"  
WINCHESTER DISK DRIVE  
OEM MANUAL



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## 1.0 Introduction

### 1.1 General Description:

The CM 5000 Series of 5¼ " Winchester Disk Drives are intended for mini- and microcomputer applications which require high speed random access disk storage at low cost. The units incorporate one, two, or three platters and utilize a Winchester-type head/media technology similar to that used in IBM-3350 type disk drives. Each platter has two data surfaces. Each data surface employs one movable head to service 306 data tracks.

The unit outline dimensions are identical to the envelope of industry-standard minifloppy disk drives and the unit requires only DC voltages for operation. These voltages are compatible with those used by industry-standard minifloppy disk drives.

Each unit consists of a drive mechanics assembly and a PCBA package which provides an industry-standard 5¼ " Winchester interface for attachment to a formatter/controller. The interface allows up to 4 drive units to be daisy chained to a single formatter/controller. All electronic components are located outside the head/disk assembly for ease of field serviceability.

Mechanical and contamination protection for the heads, actuator and disks are provided by an impact resistant aluminum enclosure. A self contained recirculating system supplies clean air through a 0.3 micron filter. A breather filter allows pressure equalization with ambient air without chance of contamination.

#### Key Features:

- Storage capacities of 6.38, 12.76, or 19.14 Mbytes unformatted.
- Winchester design reliability.
- Same physical size and mounting as standard minifloppies.
- Same DC voltages as minifloppies.
- No AC voltage requirement.
- Swing-arm and metal band positioner.
- 5.0 Megabit/second transfer rate
- Brushless DC spindle motor
- Electronic damping.
- No hysteresis positioning.
- Step-pulse buffer and velocity ramp profile

## 1.2 Summary of Specifications:

### 1.2.1 Physical Specifications:

#### Environmental Limits:

##### Ambient Temperature:

Operating = 50°F to 115°F (10°C to 46°C)

Non-operating = -40°F to 140°F (-40°C to 60°)

##### Temperature Gradient:

Operating = 18°F/hr (10°C/hr)

Non-operating = Below that which can cause condensation

Max. Wet Bulb = 78°F (25.6°C)

##### Elevation:

Operating = -100 to 6000 ft (-30 to 1828 meters)

Non-operating = -1000 to 12,000 ft. (-305 to 3656 meters)

##### Vibration:

Operating = 1g

Non-operating = 20g

##### Shock:

Operating = 5g

Non-operating = 20g

Ambient Magnetic Field TBD gauss

EMI Susceptability TBD mv/meter

##### DC Voltage Requirement:

+12 VDC  $\pm$  10% 1.5A typical (3.5A starting),  
0.5V peak-to-peak maximum ripple

+5 VDC  $\pm$  5% 0.9A typical (1.0A max.),  
50mV peak-to-peak maximum ripple

Heat Dissipation = 80BTU/hr (23 watts)

##### Mechanical Dimensions:

Height = 3.25 inch (82.6 mm)

Width = 5.75 inch (146.1 mm)

Depth = 8.00 inch (203 mm)

Weight = less than 5 lbs.

##### Media:

Oxide coated disks (IBM 3350 technology)

Outside diameter: 130 mm

Inside diameter: 40 mm

Thickness: 0.075 inch

### 1.2.2 Performance Specifications:

Capacity	<u>CM5206</u>	<u>CM5412</u>	<u>CM5619</u>
Unformatted			
Per Drive	6.38 Mbytes	12.76 Mbytes	19.14 Mbytes
Per Surface	3.19 Mbytes	3.19 Mbytes	3.19 Mbytes
Per Track	10416 Bytes	10416 Bytes	10416 Bytes
Formatted			
Per Drive	5 Mbytes	10 Mbytes	15 Mbytes
Per Surface	2.5 Mbytes	2.5 Mbytes	2.5 Mbytes
Per Track	8.2 Kbytes	8.2 Kbytes	8.2 Kbytes
Per Sector	256 Bytes	256 Bytes	256 Bytes
Sectors/Track	32	32	32
Transfer Rate	5.0 Mbits/sec	5.0 Mbits/sec	5.0 Mbits/sec
Average Latency	8.33 msec	8.33 msec	8.33 msec
Access Time			
Track-to-track	2 msec	2 msec	2 msec
Average	72 msec	72 msec	72 msec
Maximum	175 msec	175 msec	175 msec
Settling Time	13 msec	13 msec	13 msec

### 1.2.3 Functional Specifications:

	<u>CM5206</u>	<u>CM5412</u>	<u>CM5619</u>
Rotational Speed	3600 rpm	3600 rpm	3600 rpm
Speed Variation	±.1%	±.1%	±.1%
Recording Density	9180 bpi	9180 bpi	9180 bpi
Flux Density	9180 fci	9180 fci	9180 fci
Track Density	345 tpi	345 tpi	345 tpi
Cylinders	306	306	306
Tracks	612	1224	1836
R/W Heads	2	4	6
Disks	1	2	3
Index	1	1	1
Encoding Method	MFM	MFM	MFM

## 1.2.4 Reliability Specifications

MTBF: 8000 power-on hours  
PM: None required  
MTTR: 30 minutes  
Component Life: 5 years

### Error rates:

Soft read errors = 1 per  $10^{10}$  bits read  
Head read errors = 1 per  $10^{12}$  bits read  
Seek errors = 1 per  $10^6$  seeks

### Defects:

No greater than 3 defects/surface. Defects\* shall be no larger than 11 bits. Track 000 on each surface shall be defect-free.

\* Defect is defined as an area during which the signal amplitude could fall below 55% of track average amplitude or pulses which are greater than 140% of track average amplitude.



**CHAR.**

## 2.0 Functional Characteristics

### 2.1 General Description:

The CM5000 5¼" Winchester disk drive consists of Read/Write and control electronics, read/write heads, track positioning mechanism, media, and air filtration system. These components perform the following functions:

1. Interpret and generate control signals.
2. Position the heads over the desired track.
3. Read and write data.
4. Provide a contamination free environment.

### 2.2 Read/Write and Control Electronics

Electronics are packaged on two printed circuit boards. The primary board to which power, control and data signals are connected includes:

1. Index detection circuit
2. Head position/actuator drivers
3. Read/Write circuits
4. Head select circuit
5. Step motor drive circuit
6. Drive select circuit
7. Track 000 detector circuit

The primary board also includes a microprocessor which performs the following functions:

1. Controls both the spindle and stepper motor
  - a. Spindle speed controlled to .1%
  - b. Controls motor braking
  - c. Controls start-up current
  - d. Senses motor failures, power losses, etc.
  - e. Reduces power in stepper motor
  - f. Provides ramp-up and ramp-down function
2. Electronic damping
3. Track position count
4. Reduces write current
5. Prevents over-travel
6. Restores head to Track 000 on power-up.
7. Monitors write fault conditions
8. Gives fault indication
9. Controls all internal timing
10. Generates seek complete

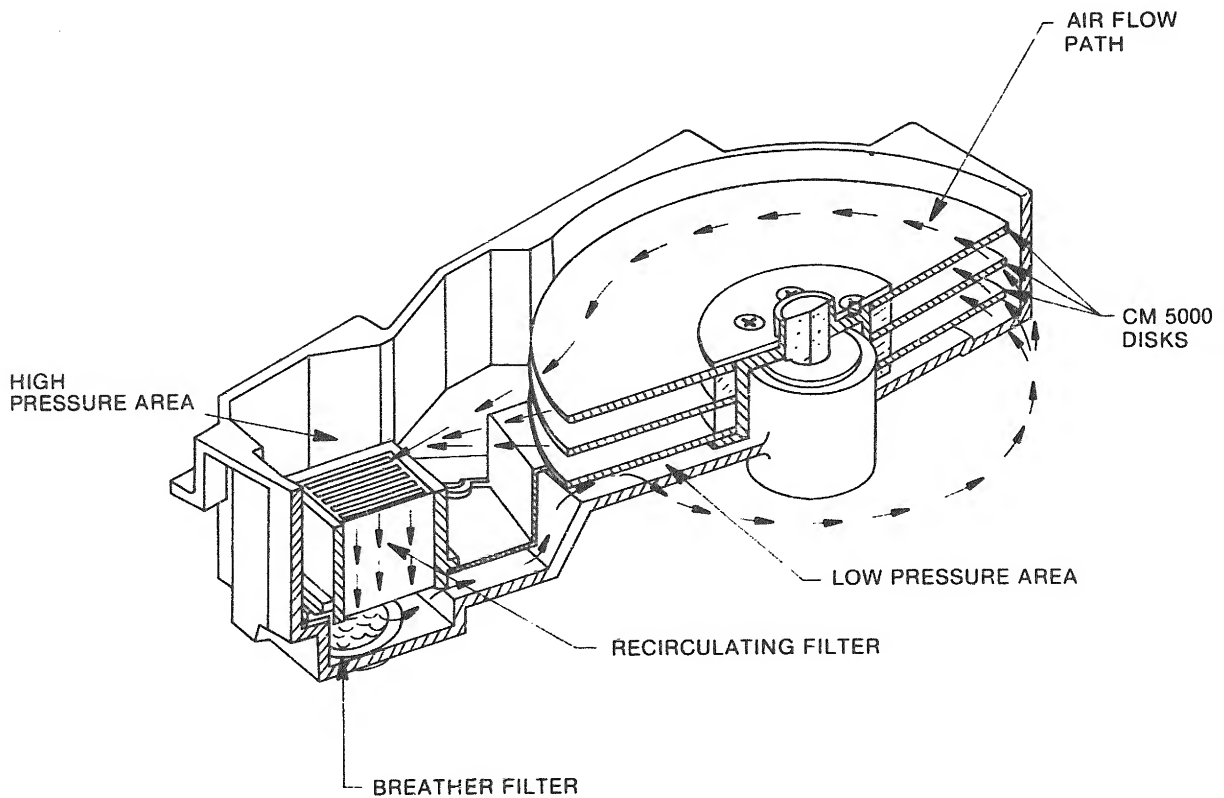
The second printed circuit board derives its power from the primary board and provides power to the spindle drive motor.

### 2.3 Drive Mechanism

A die cast base houses the recording heads, disks, and the head positioning mechanism as well as the spindle drive motor. Rotational drive for the disks is provided by a direct coupled brushless DC motor. No electronic parts are within the sealed area and electrical connections are made between the recording heads within this area and the electronics via a flexible circuit cable.

## 2.4 Air Filtration System (Figure 1)

The disks and read/write heads are fully enclosed in a module using an integral recirculation air system with an absolute recirculating filter which maintains a clean environment. A separate absolute breather filter permits pressure equalization with the ambient air without contamination.



CM 5000 AIR CIRCULATION SYSTEM  
FIGURE 1.

## 2.5 Positioning Mechanism (Figure 2)

The positioner is a swing arm mechanism supported on two preloaded ball bearings. The system is designed to accept between 2 and 6 heads depending on the model number. The swing arm is connected via a connecting arm to a metal band/stepping motor actuator system. Each 0.9 degrees rotation of the high precision stepping motor moves the recording heads one track in discrete increments.

## 2.6 Read/Write Heads and Disks

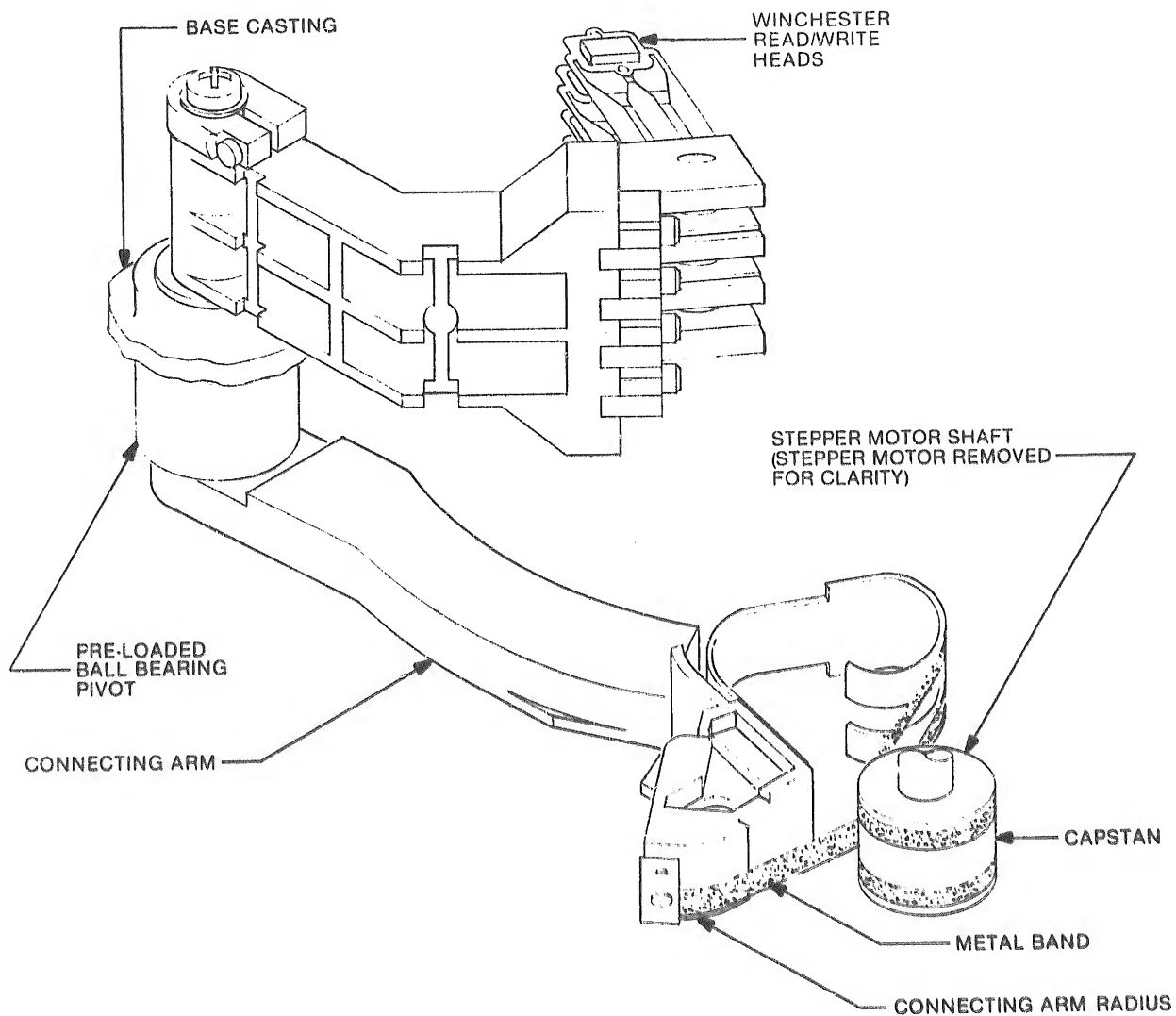
The recording media consists of a lubricated thin magnetic oxide coating on a 130mm outside diameter aluminum substrate. This coating formulation, together with the low load force/low mass Winchester type flying heads, permit reliable contact start/stop operation.

Data on each disk surface is read by one read/write head which accesses 306 tracks. The drive is available in three basic configurations:

- one disk with two read/write heads (CM5206)
- two disks with four read/write heads (CM5412)
- three disks with six read/write heads (CM5619)

## 2.7 Read/Write Head Landing Zone

to be added.....



CM 5000 POSITIONING SYSTEM  
FIGURE 2.

### **3.0 Functional Operations**

#### **3.1 Power Sequencing**

The DC voltages, +5v and +12v, may be applied in any order. When the voltages are applied to the drive and the power sense circuit determines that all voltages are within limits, the initial load sequence occurs. This sequence consists of running the spindle up to operating speed and positioning the heads over Cylinder 000.

#### **3.2 Drive Selection**

Drive selection occurs when one of the drive select lines are activated. Only the drive appropriately jumpered will respond to the input signals, and that drive's output signals are then gated to the controller.

#### **3.3 Track Accessing**

Read/Write head positioning is accomplished by:

- a) Deactivating Write Gate
- b) Activating the appropriate Drive Select Line.
- c) Being in the Ready condition with seek complete true.
- d) Selecting the appropriate direction.
- e) Pulsing the Step line.

Each step pulse will cause the heads to move either one track in or one track out depending on the status of the Direction Line. A true on the Direction line will cause a seek inward toward the spindle; a false outward toward track 000. Step pulses may be issued to the drive at a rate as fast as  $5\mu\text{s}$  between pulses. The drive will automatically ramp up to as fast as 0.7 msec between tracks before ramping down and settling on the track. Seek complete will go true when the R/W heads have settled on the final track at the end of a seek.

#### **3.4 Head Selection**

Any of the 6 possible heads can be selected by placing that head's binary address on the three Head Select lines.

#### **3.5 Read Operation**

Reading data from the disk is accomplished by:

- a) Deactivating the Write Gate line.
- b) Activating the appropriate Drive Select line.
- c) Assuring the drive is Ready.
- d) Selecting the appropriate head.

#### **3.6 Write Operation**

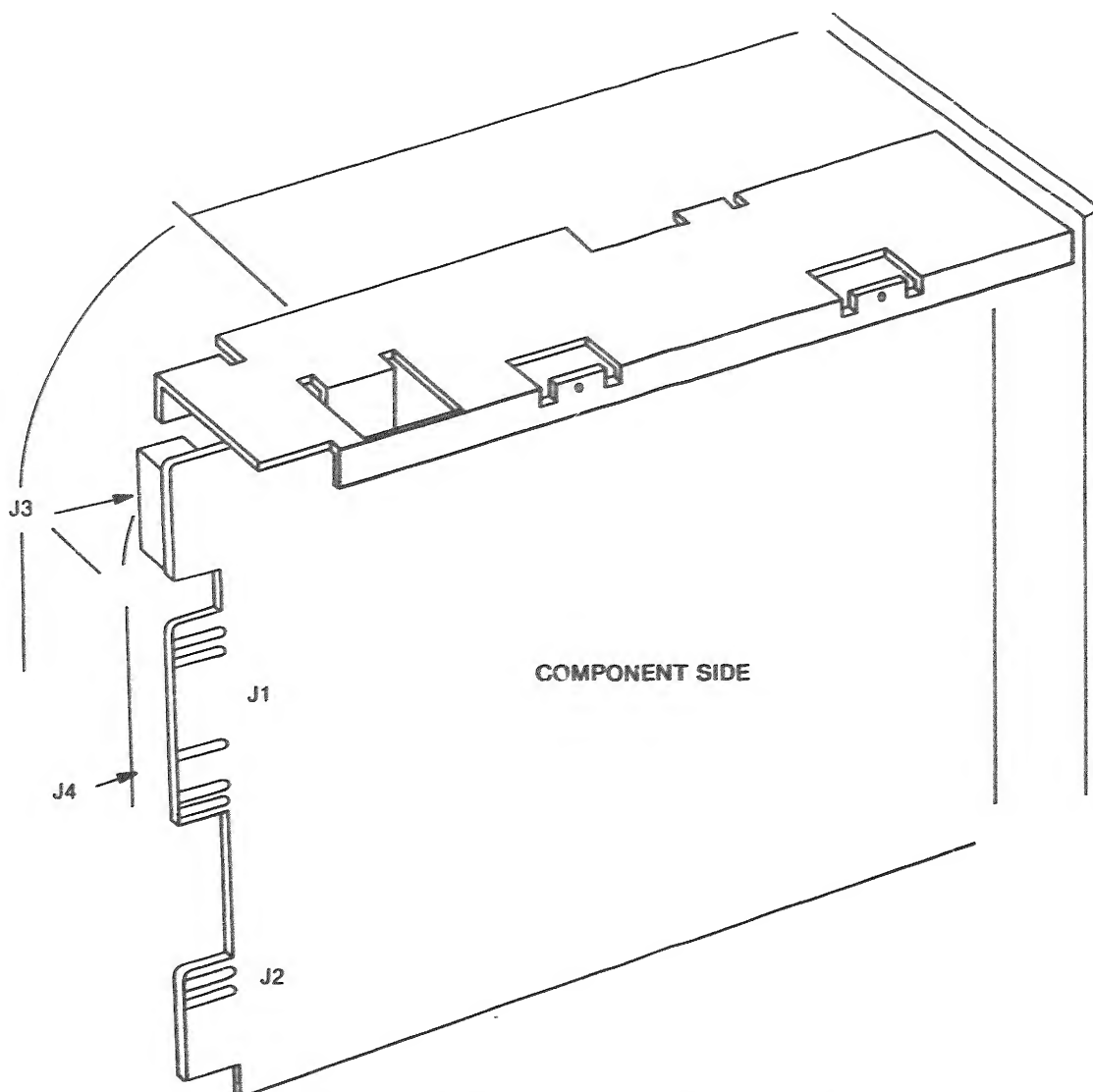
Writing data onto the disk is accomplished by:

- a) Activating the appropriate Drive Select line.
- b) Assuring that the drive is Ready.
- c) Selecting the proper head.
- d) Insuring no write fault conditions exist.
- e) Activating Write Gate and placing data on the Write Data line.

## 4.0 Electrical Interface

### 4.1 Physical Interface

The interface of the drive can be divided into three categories: Control, Signal and DC power. Table I, II and III define the pin assignments for these interface lines. Tables IV and V show the recommended cable type, and the grounding configuration at the drive and at the host systems. Figure 3 indicates the physical location of the connectors. Figure 4 indicates a typical connection for a four drive system.



INTERFACE CONNECTOR PHYSICAL LOCATION

FIGURE 3.

TABLE I J1/P1 CONNECTOR PIN ASSIGNMENT

<u>GND RTN PIN</u>	<u>SIGNAL PIN</u>	<u>SIGNAL NAME</u>
1	2	- SPARE
3	4	- HEAD SELECT 2 <sup>2</sup>
5	6	- WRITE GATE
7	8	- SEEK COMPLETE
9	10	- TRACK 000
11	12	- WRITE FAULT
13	14	- HEAD SELECT 2°
15	16	RESERVED (TO J2 PIN 7)
17	18	- HEAD SELECT 2 <sup>1</sup>
19	20	- INDEX
21	22	- READY
23	24	- STEP
25	26	- DRIVE SELECT 1
27	28	- DRIVE SELECT 2
29	30	- DRIVE SELECT 3
31	32	- DRIVE SELECT 4
33	34	- DIRECTION IN



TABLE II J2/P2 CONNECTOR PIN ASSIGNMENT

<u>GND RTN PIN</u>	<u>SIGNAL PIN</u>	<u>SIGNAL NAME</u>
2	1	- DRIVE SELECTED
4	3	RESERVED
6	5	- WRITE DISABLE
8	7	RESERVED (TO J1 PIN 16)
10	9	SPARE
12	11	GND
	13	+ MFM WRITE DATA
	14	- MFM WRITE DATA
16	15	GND
	17	+ MFM READ DATA
	18	- MFM READ DATA
20	19	GND

TABLE III P3 — DC CONNECTOR PIN ASSIGNMENTS

VOLTAGE	GROUND
PIN 1 + 12 VOLTS DC	PIN 2 + 12 VOLT RETURN
PIN 4 + 5 VOLTS DC	PIN 3 + 5 VOLT RETURN

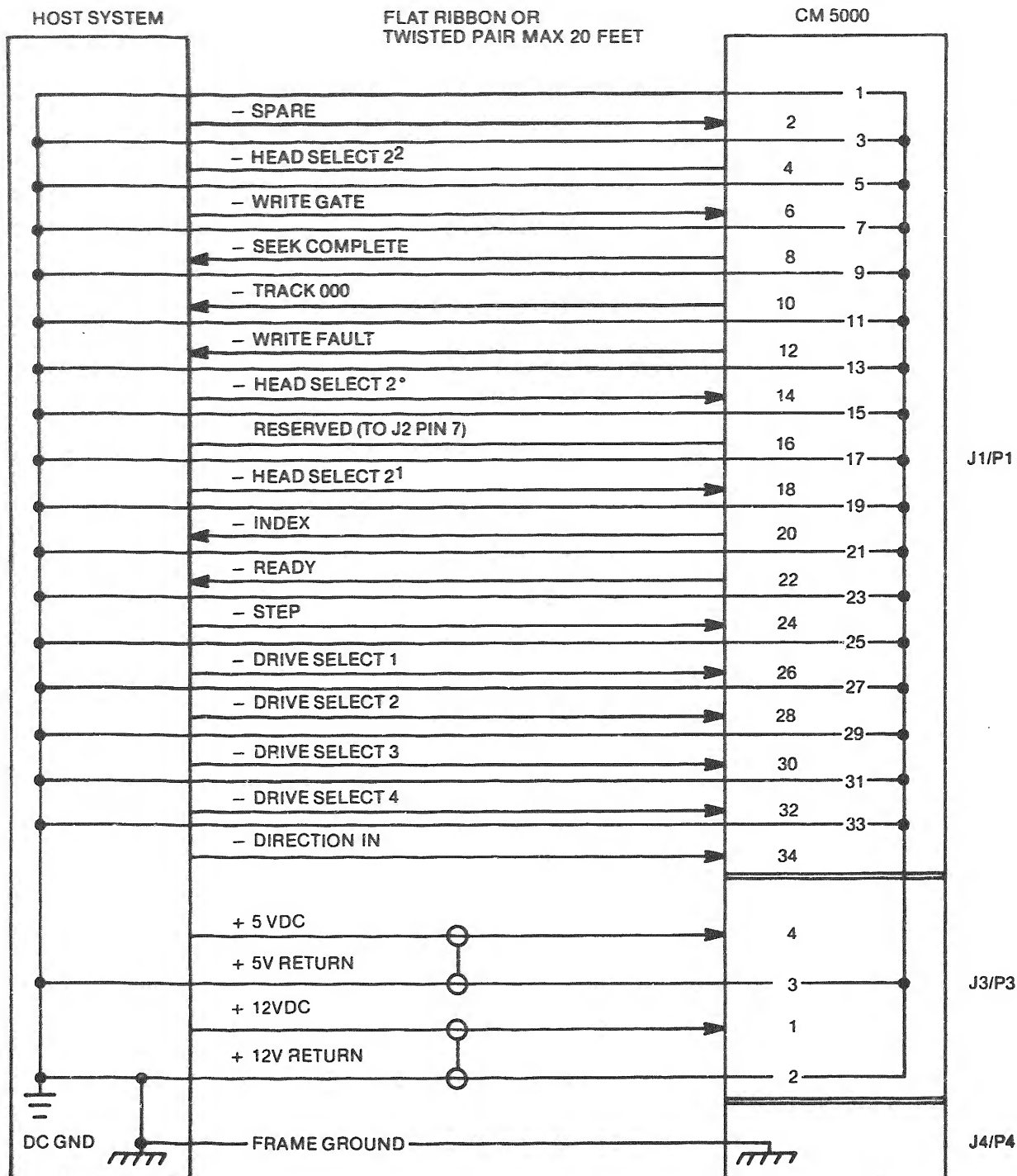


TABLE IV SINGLE DRIVE SYSTEM J2/P2 NOT SHOWN

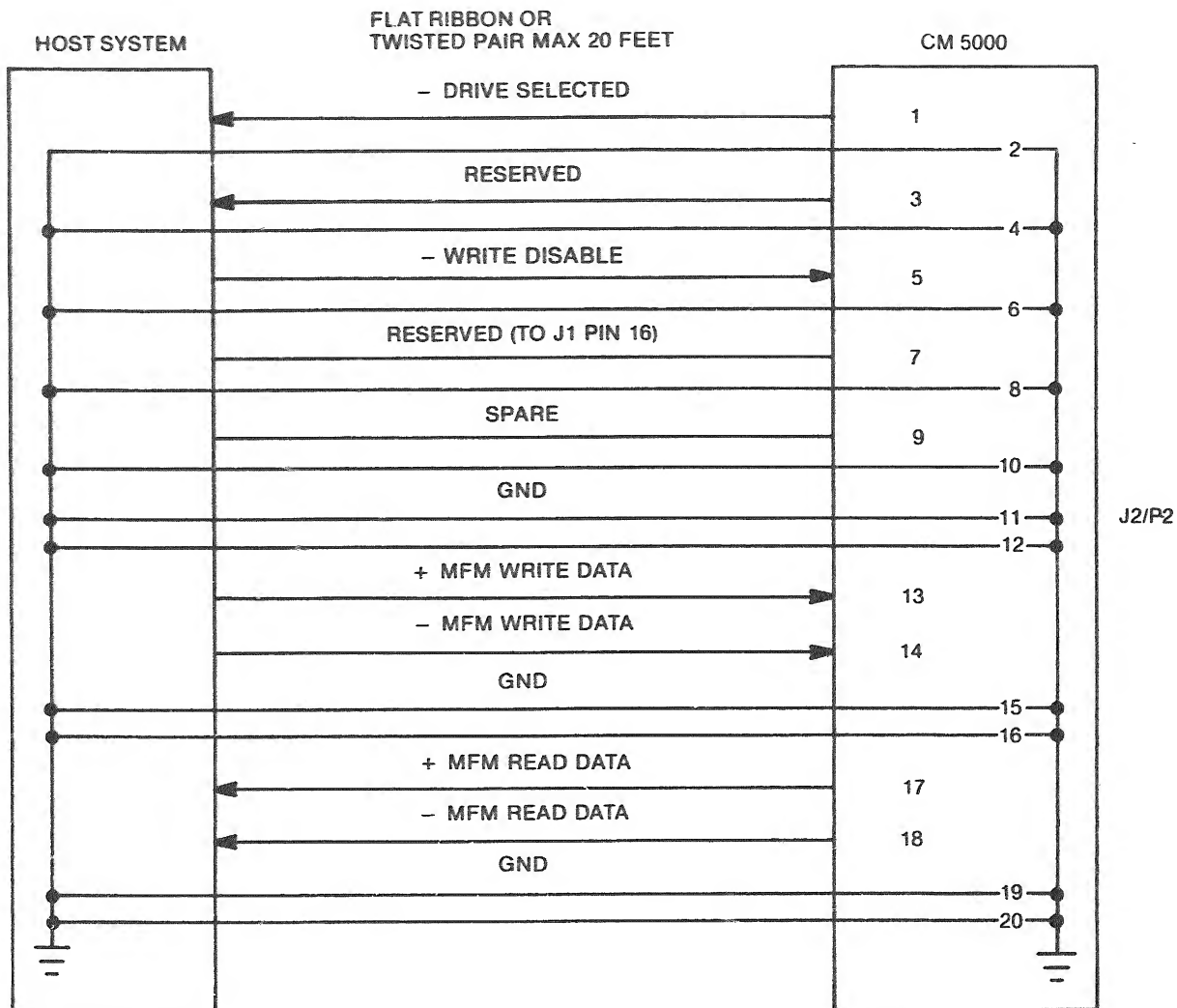


TABLE V SINGLE DRIVE SYSTEM J2/P2

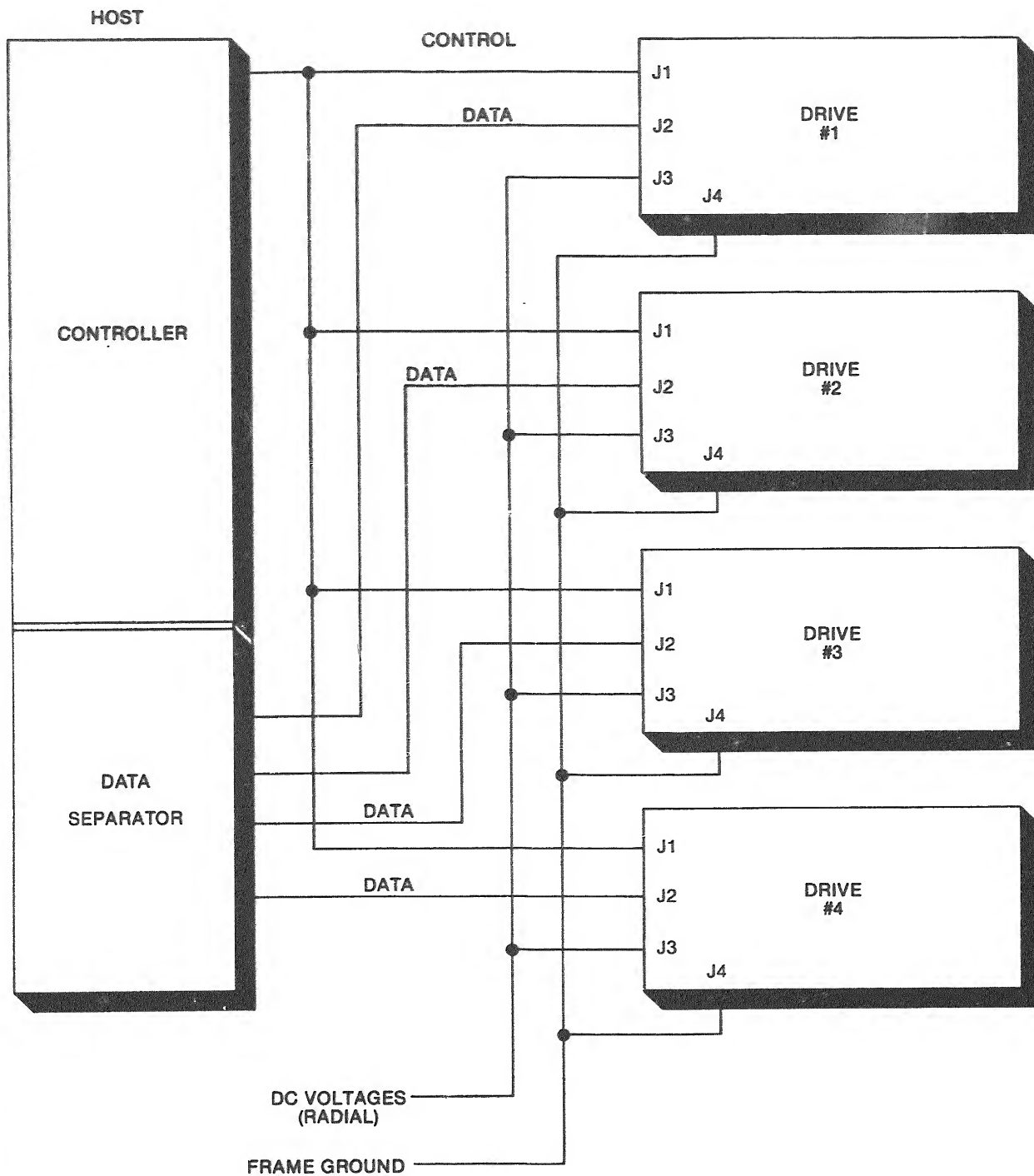


FIGURE 4.

#### 4.1.1 J1/P1 CONNECTOR

Connection to J1 is via a 34 pin PCB edge connector. The dimensions for this connector are shown in Figure 5. The pins are numbered 1 through 34 with the even pins located on the component side of the PCB. Pin 2 is located on the end of the PCB connector closest to the DC power connector J3/P3. A key slot is provided between pins 4 and 6. The recommended mating connector for P1 is AMP ribbon connector PIN 88373-3.

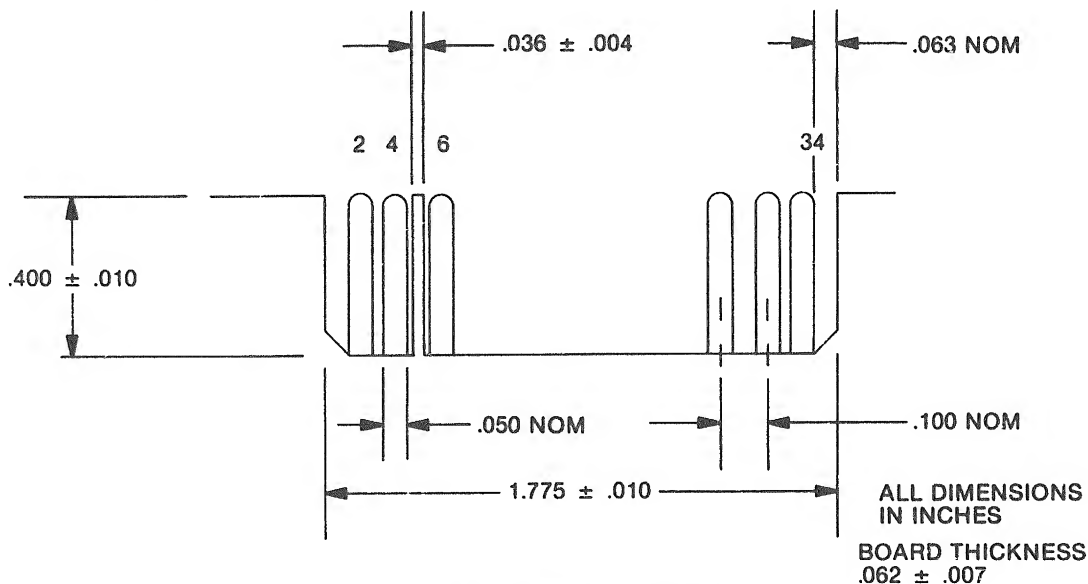


FIGURE 5. J1 CONNECTOR DIMENSIONS

#### 4.1.2 J2/P2 CONNECTOR

Connection to J2 is via a 20 pin PCB edge connector. The dimensions for the connector are shown in figure 6. The pins are numbered 1 through 20 with the even pins located on the component side of the PCB. The recommended mating connector for P2 is AMP ribbon connector P/N 88373-6. A key slot is provided between pins 4 and 6.

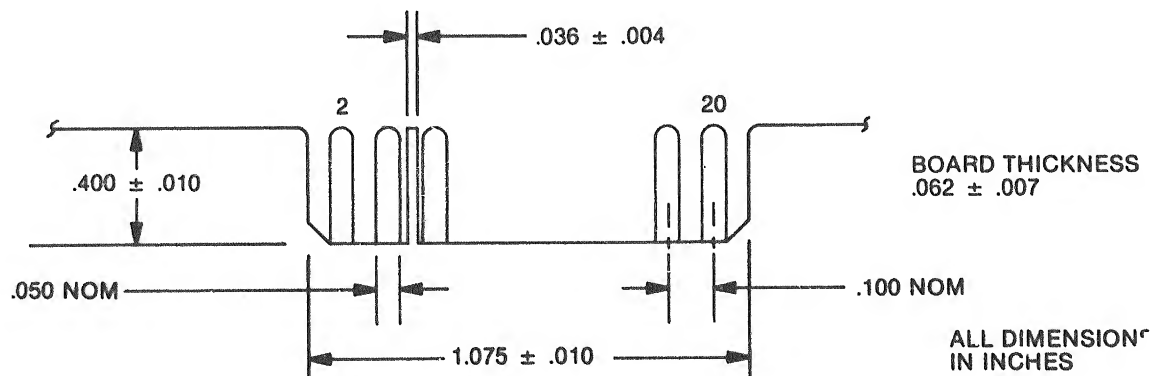


FIGURE 6. CONNECTOR DIMENSIONS

#### 4.1.3 J3/P3 CONNECTOR

The DC Power connector (J3), Figure 7, is a 4 pin AMP MATE-N-LOK connector P/N 350211-1 mounted on the solder side of the PCB. The recommended mating connector (P3) is AMP P/N 1-480424-0 utilizing AMP pins P/N 350078-4.

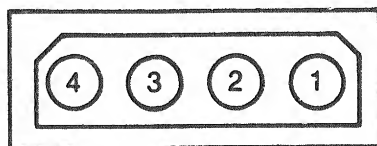


FIGURE 7 J3 CONNECTOR (DRIVE PCB SOLDER SIDE).

The required voltages and current levels on connector J3/P3 are shown below.

DC VOLTAGE	CURRENT	
	MAX.	TYP.
+ 12 $\pm$ 1.2V 0.5 V P-P Max. Ripple	3.5A (Start current)	1.5A
+ 5 $\pm$ 0.25V 50mV P-P Max. Ripple	1.0A	0.9A

#### 4.1.4 J4/P4 FRAME GROUND CONNECTOR FASTON AMP P/N 62275-1

## 4.2 Interface Lines and Pin Assignments

### 4.2.1 CONTROL INPUT LINES

The control input signals are of two types: those to be multiplexed in a multiple drive system and those intended to do the multiplexing. The control input signals to be multiplexed are, WRITE GATE, HEAD SELECT 2<sup>0</sup>, HEAD SELECT 2<sup>1</sup>, HEAD SELECT 2<sup>2</sup>, STEP and DIRECTION IN. The signal to do the multiplexing is DRIVE SELECT 1, DRIVE SELECT 2, DRIVE SELECT 3, or DRIVE SELECT 4.

The input lines have the following electrical specifications. Refer to figure 8 for the recommended circuit.

TRUE: 0.0VDC to 0.4 VDC @ 1 = - 40 mA (max)

FALSE: 2.5VDC to 5.25 VDC @ I = 0mA (Open)

Each control input line is terminated by a 220/330 resistor pack as shown in figure 5.

#### 4.2.1.1 DRIVE SELECT 1, 2, 3, AND 4.

The Drive Select lines, when true, enable the input lines of the correspondingly programmed drive(s). Only one Drive Select line should be true at any time.

#### 4.2.1.2 HEAD SELECT 2<sup>0</sup>, 2<sup>1</sup>, AND 2<sup>2</sup>

These lines provide for the selection of each individual read/write head in a binary coded sequence. HEAD SELECT 2<sup>0</sup> is the least significant address line. Heads are numbered 0 and 1 on the CM 5206; 0 through 3 on the CM 5412 and 0 through 5 on the CM 5619.

#### 4.2.1.3 WRITE GATE

The active (true) state of this signal enables write data to be written on the selected disk of the selected drive provided that READY and SEEK COMPLETE are true, WRITE DISABLE is false and no WRITE FAULT exists on the selected drive. The inactive state of WRITE GATE permits the STEP pulses to step the R/W actuator on the selected and READY drive or it enables data to be transferred from that drive if SEEK COMPLETE is true.

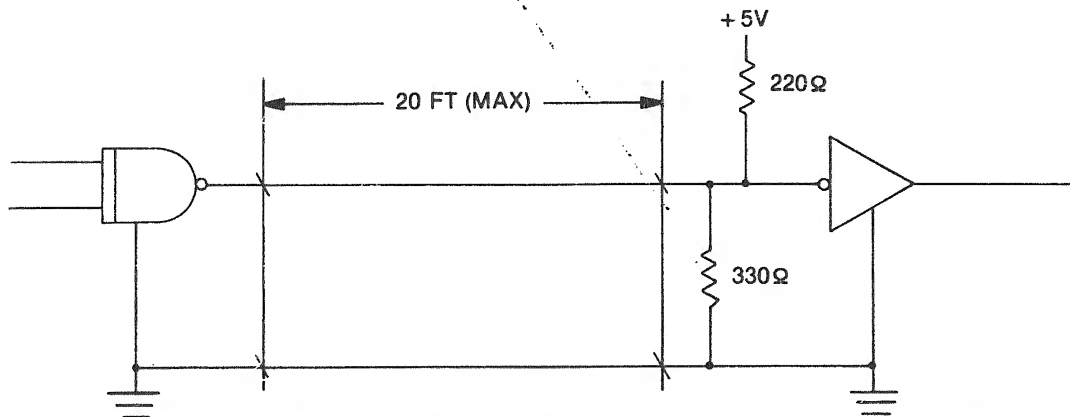


FIGURE 8. CONTROL SIGNAL DRIVER/RECEIVER COMBINATION

#### 4.2.1.4 STEP

This is a control signal which causes the R/W head to move in the direction of motion defined by the DIRECTION IN line. In the seeking mode the head moves one track for each STEP pulse.

Motion is initiated by the leading edge (i.e. false to true) of the STEP pulse. Any change in the DIRECTION line must be made at least 100nS before the leading edge of the STEP pulse.

STEP pulses may be issued at any interval as low as 5 $\mu$ S. The minimum pulse width is 2.0 $\mu$ S.

See figure 9 for STEP pulse timing.

In a restore (recalibration) operation the minimum interval between successive STEP pulses should be 3.0mS.

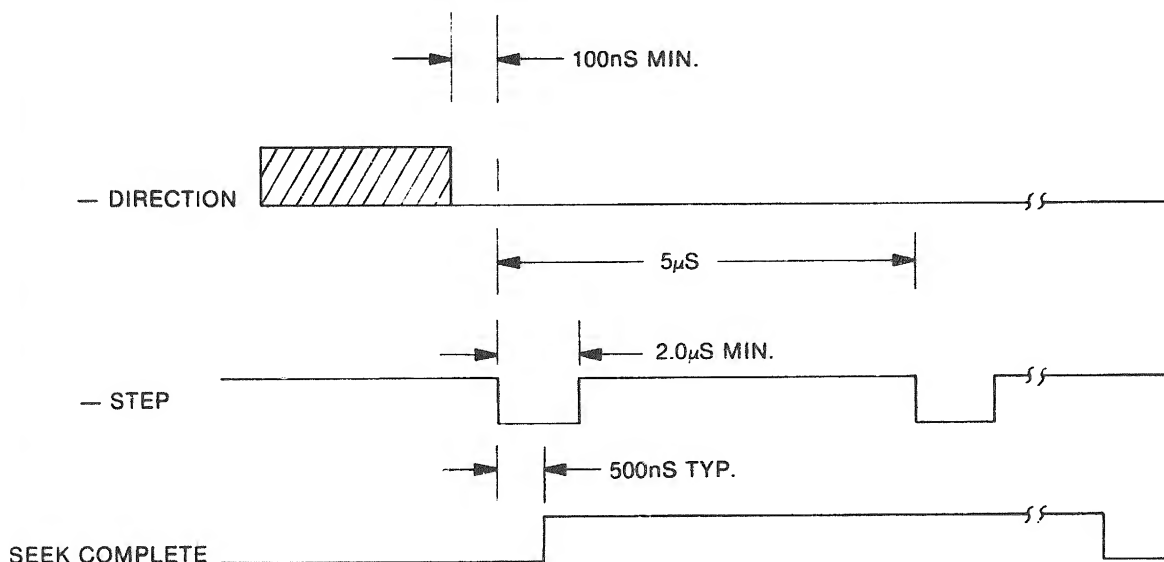


FIGURE 9. STEP PULSE TIMING

#### 4.2.1.5 DIRECTION IN

This signal defines the direction of motion of the R/W head when the STEP line is pulsed. When the signal is false the direction is defined as "out" and a STEP pulse causes the R/W heads to move away from the center of the disk. When this line is true the direction is defined as "in" and the heads will move toward the center of the disk. The tracks are numbered 000 through 305 and track 000 is the outermost track. If an attempt is made to seek out beyond track 000 or in beyond track 305 the actuator will stop when one of these extremes is reached.

Once a move has been initiated no attempt should be made to reverse the direction of seeking while the SEEK COMPLETE Line is false.



#### 4.2.2 Control Output Lines

The output control lines are driven with an open collector output stage capable of sinking a maximum of 40mA at the true or active state with a maximum voltage of 0.4V measured at the driver. In the false or inactive state the output transistor is off and the maximum collector cutoff current is 250 $\mu$ A.

The output control lines are enabled by the programmed DRIVE SELECT Line.

The recommended circuit is shown in figure 8.

##### 4.2.2.1 SEEK COMPLETE

This line will go true when the R/W heads have settled on the final track at the end of a seek.

The SEEK COMPLETE Line will go false at the following times:

- a) During the power on sequence while the drive logic is in the process of restoring the R/W heads to track 000.
- b) Approximately 500nS after the leading edge of the first in any series of STEP pulses.

The minimum duration which this line will remain in the false state is approximately 15.0mS.

Writing is inhibited when SEEK COMPLETE is false. Any attempt to write during this period will generate a WRITE FAULT. When false SEEK COMPLETE also inhibits the transmission of MFM READ DATA.

No attempt should be made to reserve the direction of stepping when SEEK COMPLETE is false.

##### 4.2.2.2 TRACK 000

The true state of this line is generated when the R/W heads are on their last step approaching track 000, i.e., when they are moving from track 001 to track 000. It remains true as long as the heads are positioned at track 000. Track 000 is the outermost track.

##### 4.2.2.3 WRITE FAULT

This signal is used to indicate that a condition exists in the drive which causes improper writing on the disk(s). When this line is true, further writing is inhibited at the drive until the condition is corrected.

The following conditions are detected:

- a) Write current in a head without WRITE GATE active.
- b) No write current in a head with WRITE GATE active and DRIVE SELECTED.
- c) WRITE GATE active when WRITE DISABLE is true.
- d) The DC voltages are grossly out of tolerance.

#### 4.2.2.3 WRITE FAULT (cont.)

WRITE FAULT may be cleared by de-selecting the drive for a period exceeding  $50\mu\text{secs}$ , otherwise the condition will automatically clear 2 msecs after the conditions generating the fault have been removed.

Writing is inhibited internally during seeking or if WRITE GATE is true at the time of SEEK COMPLETE going true.

#### 4.2.2.4 INDEX

The leading edge (i.e. false to true) of this pulse indicates the beginning of each track. The pulse occurs once per revolution of the disk (16.67 mS nom.).

#### 4.2.2.5 READY

When the READY line is true together with SEEK COMPLETE the drive is ready to seek or read and if in addition the heads are not offtrack it is also ready to write. When this line is false the I/O signals are not valid, also, writing, seeking and the transmission of read data are inhibited.

At power on the READY line goes true when the DC voltages are within tolerance, the disks are rotating at the correct speed and the heads are positioned at track 000.

The READY Line will go false when the DC voltages are out of tolerance and/or the disks fail to maintain regulated speed.

### 4.3 DATA TRANSFER LINES

The data transfer lines are provided at the J2/P2 connector. They are differential in nature and may not be multiplexed.

Two pairs of balanced signals are used for the transfer of data, one pair each for MFM WRITE DATA and MFM READ DATA. Figure 11 illustrates the driver/receiver combination used in the CM 5000 drive for data transfer signals.

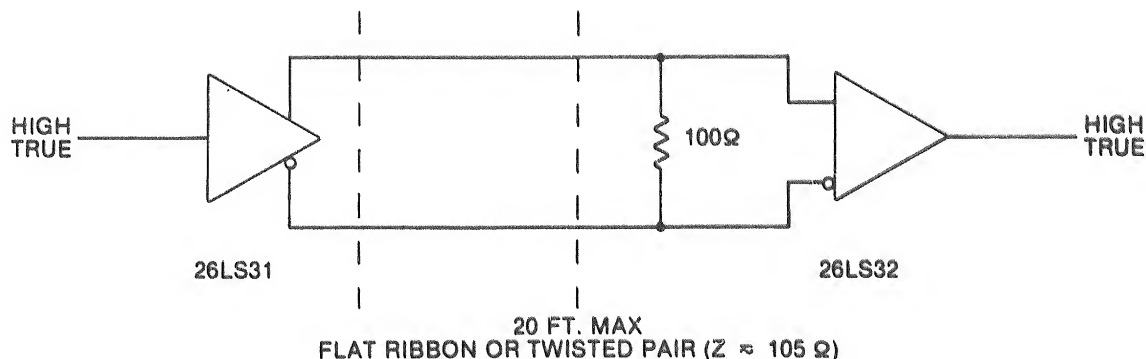


FIGURE 11. DATA LINE DRIVER/RECEIVER

#### 4.3.1 MFM WRITE DATA

This is a differential pair that defines the transitions to be written on the track. When WRITE GATE is active the transition of the signal + MFM WRITE DATA going more positive than - MFM WRITE DATA causes a flux reversal to be recorded on the track. When WRITE GATE is inactive the host system must hold + MFM WRITE DATA more negative than - MFM WRITE DATA.

The standard MFM write data transmission rate is 5.000 Mbits/sec. The write data timing is shown in figure 12. The actual occurrence of the flux reversals may differ due to write precompensation.

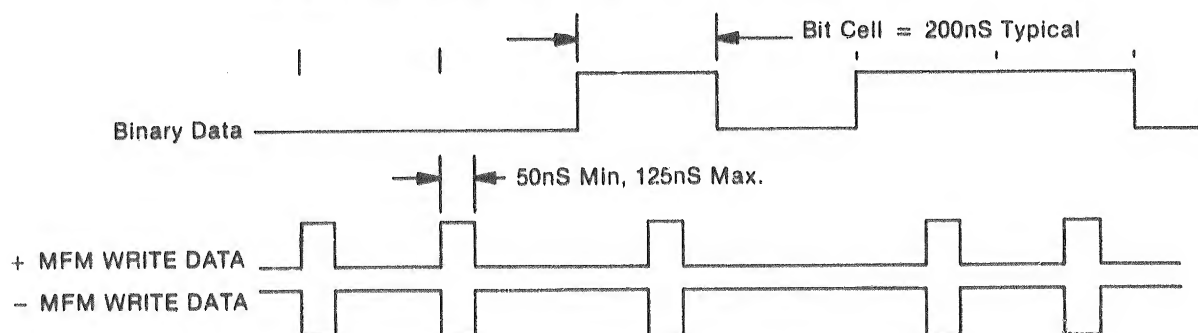


FIGURE 12. MFM WRITE DATA TIMING.

#### 4.3.2 MFM READ DATA

Data recovered from a pre-recorded track is transmitted to the host system via a differential pair of MFM READ DATA lines. The transition of the + MFM READ DATA line going more positive than the - MFM READ DATA line represents a flux reversal on the track of the selected head.

Read data is suppressed during writing and seeking operations and also when the drive is not selected. Following a write operation and/or a HEAD SELECT change the read data will not be valid for a period of up to  $10\mu\text{S}$ . If the drive is already selected at the end of a seek operation, read data will appear immediately upon SEEK COMPLETE. When the drive has been deselected, read data will not re-appear for a period of up to  $100\mu\text{S}$  after it is reselected.

Typical MFM read data timing is shown in figure 13.

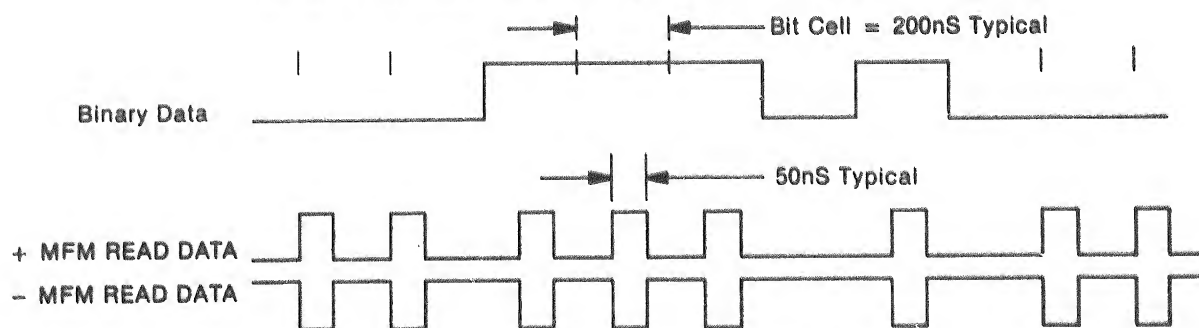


FIGURE 13. MFM READ DATA TIMING.

#### 4.3.3. WRITE DISABLE

Writing to the disk is inhibited when WRITE PROTECT is active irrespective of the condition of WRITE GATE. If WRITE GATE and WRITE PROTECT are both active simultaneously then WRITE FAULT is set.

#### 4.3.4 DRIVE SELECTED

This status line is provided at the J2/P2 connector to inform the host system of the selection status of the drive.

The DRIVE SELECTED Line is driven by a TTL open collector driver as shown in figure 8. When the appropriate DRIVE SELECT line at J1/P1 is activated by the host system this signal will go active on the correspondingly programmed drive.

### 4.4 GENERAL TIMING REQUIREMENTS

Figure 14 is a timing diagram showing the necessary sequence of events and associated timing restrictions for proper operation of the drive.

Note that an automatic recalibration to track zero occurs at DC power on. At DC power off the disks are brought to a complete stop in approximately 20Secs.

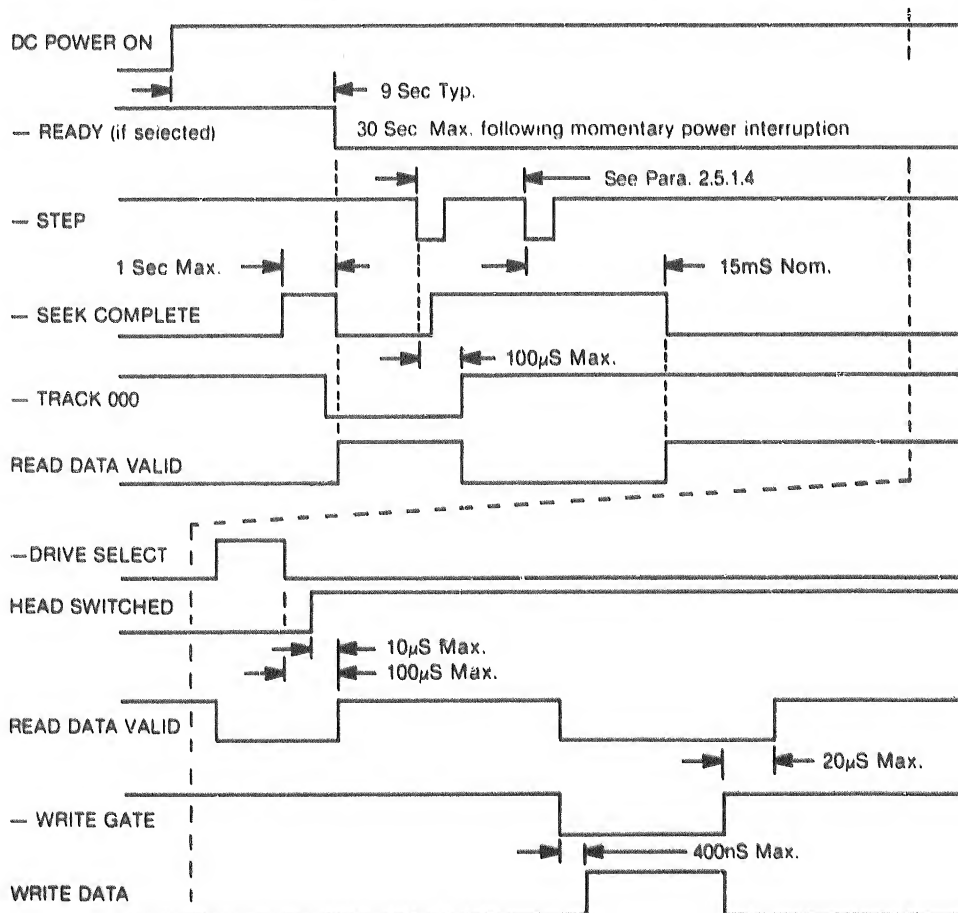


FIGURE 14. GENERAL TIMING REQUIREMENTS.

## 5.0 Physical Specifications

This section describes the mechanical and mounting recommendations for the CM 5000.

### 5.1 Mounting Orientation

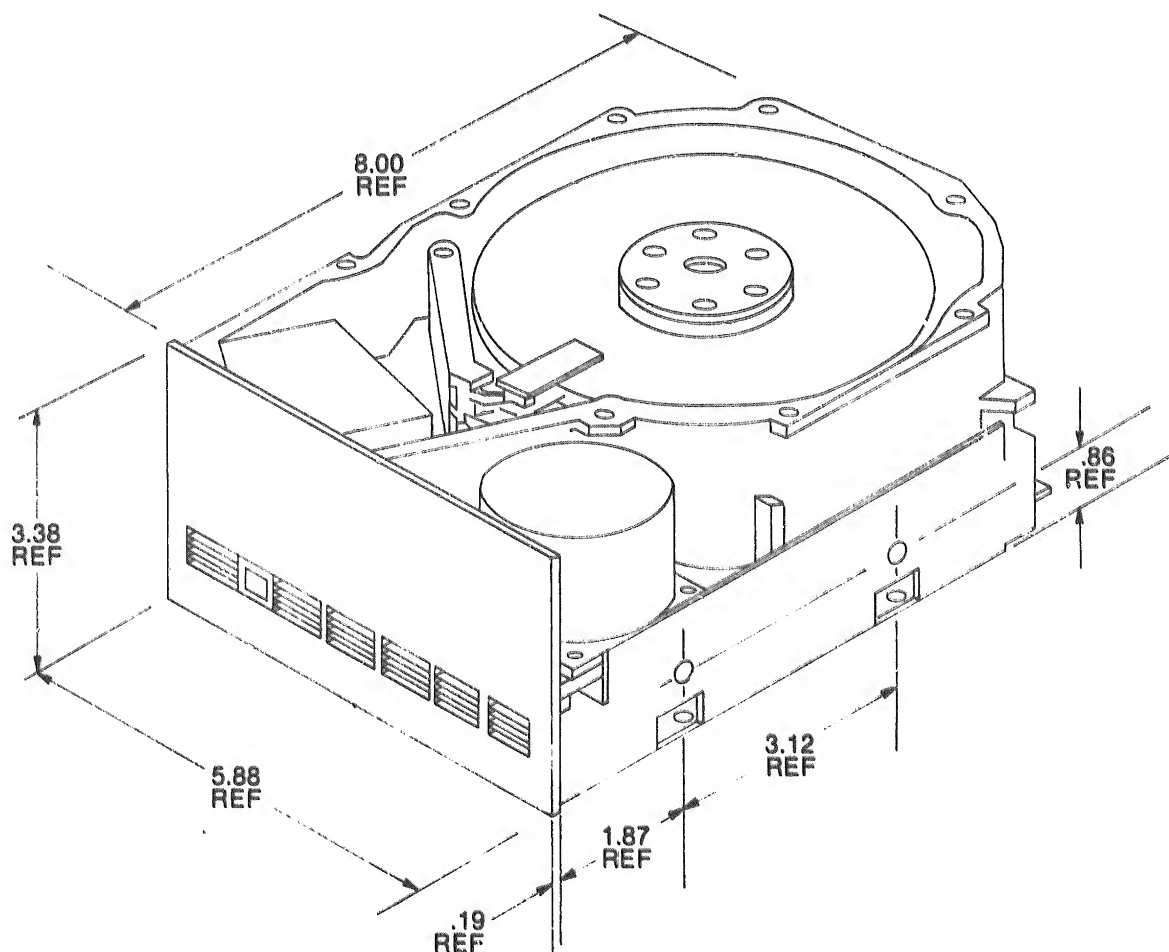
The CM 5000 may be mounted in any orientation. In the final mounting configuration, insure that operation of the four shock mounts which isolate the base casting from the frame is not restricted.

### 5.2 Mounting Holes

Eight mounting holes, four on bottom and two on each side are provided for mounting the drive into an enclosure. The size and location of these holes, shown in Figure 15, are identical to industry standard minifloppy drives.

### 5.3 Physical Dimensions

Overall height/width/depth and other key dimensions are shown in Figures 15 and 16.



CM500 MECHANICAL OUTLINE  
GENERAL PERSPECTIVE.

FIGURE 15.

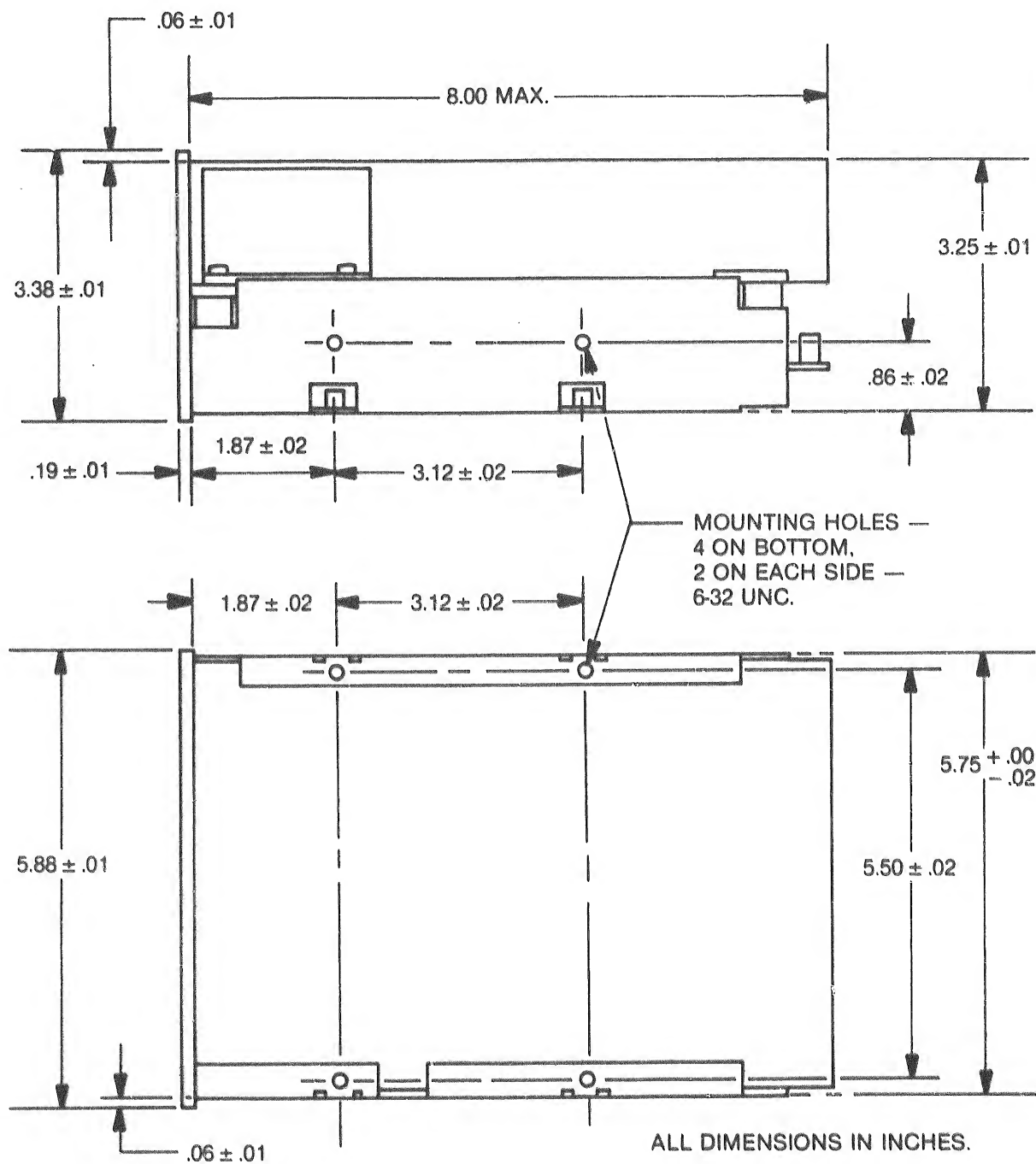


FIGURE 16. CM5000 MECHANICAL OUTLINE  
BOTTOM AND SIDE VIEWS.

## **6.0 Media Defect and Errors**

Any defects on the media surface will be identified on a defect map provided with each drive. This defect map will indicate the Head number, Track number, and number of bytes from index for each defect. The maximum number of defects/surface is three (3) with track 000 certified to be defect-free on each surface. Each defect shall be no longer than 11 bits (a defect is defined as an area during which the signal amplitude could fall below 55% of track average amplitude or pulses which are greater than 140% of track average amplitude)

## 7.0 CM 5000 Jumper Options

All jumper options are shown in Figure 17 and Table VI.

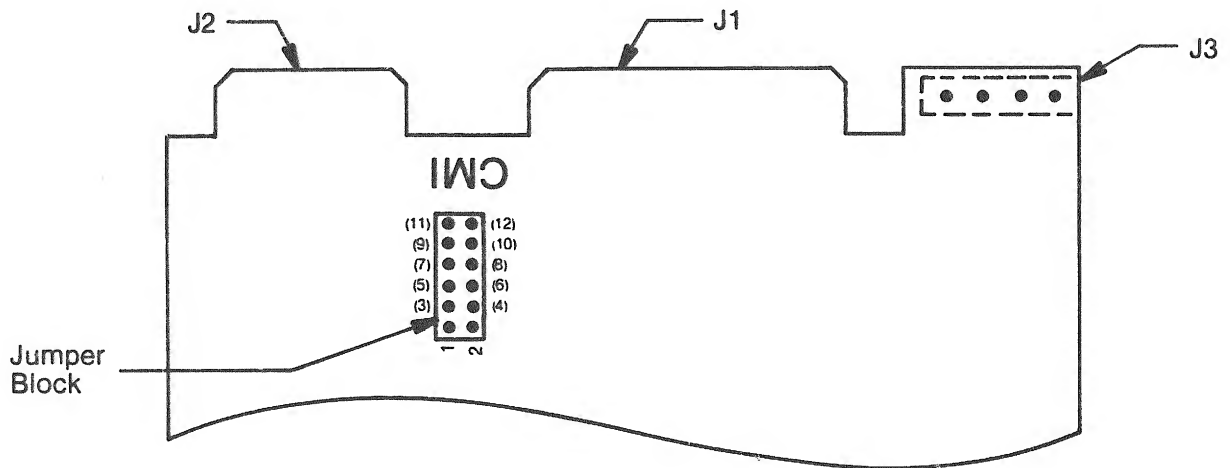


FIGURE 17

Function	Jumper Block Pin Numbers
Drive Select 0	1, 2
Drive Select 1	3, 4
Drive Select 2	5, 6
Drive Select 3	7, 8
Reserved	9, 10
Reserved	11, 12

TABLE VI



## 8.0 Warranty and Shipping Information

Should the disk drive fail to operate properly during the warranty period, return the drive to Computer Memories in accordance with the steps listed under Shipping Information.

### 8.1 USA Shipping Information

1. Call Computer Memories Inc. order entry department for a return material authorization (RMA) number.

Phone number: (213) 709-6445

2. Pack the disk drive in its original shipping container, or equivalent.

3. Send the disk drive to the Computer Memories repair facility at:  
9233 Eton Avenue  
Chatsworth, California 91311

### 8.2 European Shipping Information

Kode Services Limited is the approved repair facility in the United Kingdom, the Republic of Ireland and Europe. Customers in these areas should contact:

Kode Services Limited  
Station Road, Calne  
Wiltshire, SN11 OJR, England.  
Telephone Calne (0249) 813771.  
Telex: 449335

Shipping costs to the factory are the customer's responsibility. Computer Memories Incorporated cannot assume any responsibility for loss or damage to shipments. For your protection, please send your disk insured. Computer Memories will return the repaired drive to the customer freight prepaid.

To reduce the risk of shipping damage, disk drives should be shipped in the original container. Containers can be purchased from the factory if you have discarded the original. Customers who do not return equipment to the factory in the original shipping container will be invoiced for the cost of a new container.

CM 5000 5¼" WINCHESTER DISK DRIVE OEM MANUAL

ERRATA SHEET

1. Page ii, Table of Contents

After Section 8.0 Add:

9.0 Write Precompensation 9.1

2. Page 1-2, Section 1.2

Vibration:

Non-Operating=20g

Should be:

Non-Operating=3g

3. Page 1-2, Section 1.2

EMI Susceptability TBD mv/Meter

Should be:

EMI Susceptability 1V/Meter 50kHz to 300mHz

4. Page 1-3, Section 1.2.2

Access Time

Track-to-Track 2 msec

Average 72 msec

Maximum 175 msec

Settling Time 13 msec

Should be:

Track-to-Track 2 msec

Average 77 msec

Maximum 179 msec

Settling Time 16 msec

5. Page 1-4, Section 1.2.4

MTBF 8000 Power-on Hours

Should be:

MTBF 10000 Power-on Hours

6. Page 2-3, Section 2.7

Read/Write Head Landing Zone

To be added....

Delete This Section

7. Page 4-11, Section 4.2.2.1

Last Paragraph:

"No attempt should be made to reserve..."

Should be:

"No attempt should be made to reverse..."

8. Page 4-13, Section 4.3.2

Figure 13, Bottom Diagram

+ MFM Read Data Pulse Width 50nsec Typical

Should be:

50nsec Minimum, 70nsec Typical

9. Page 4-14, Section 4.4

Figure 14, Third Diagram From Bottom of Page:

Time From Drive Select to Read Data Valid is 100usec Max.

Should be:

1usec Max.

10. Page 5-1, Figure 15

Diagram Heading "CM 500 Mechanical Outline"

Should be:

"CM 5000 Mechanical Outline"

11. Page 9-1

After Page 8-1 Add New Page 9-1

On Page 9-1, Add:

9.0 Write Precompensation

To assure data integrity, the write data presented by the host may be precompensated on tracks 121 through 305.

The optimum amount of precompensation is 10nsec. Figure 18 shows the bit patterns to be compensated. All other patterns should be written "on time." "On time" represents a nominal delay. Early and late represents less or more delay, respectively.

12. Page 9-2

After Page 9-1, Add New Page 9-2 and Attach Figure 18.

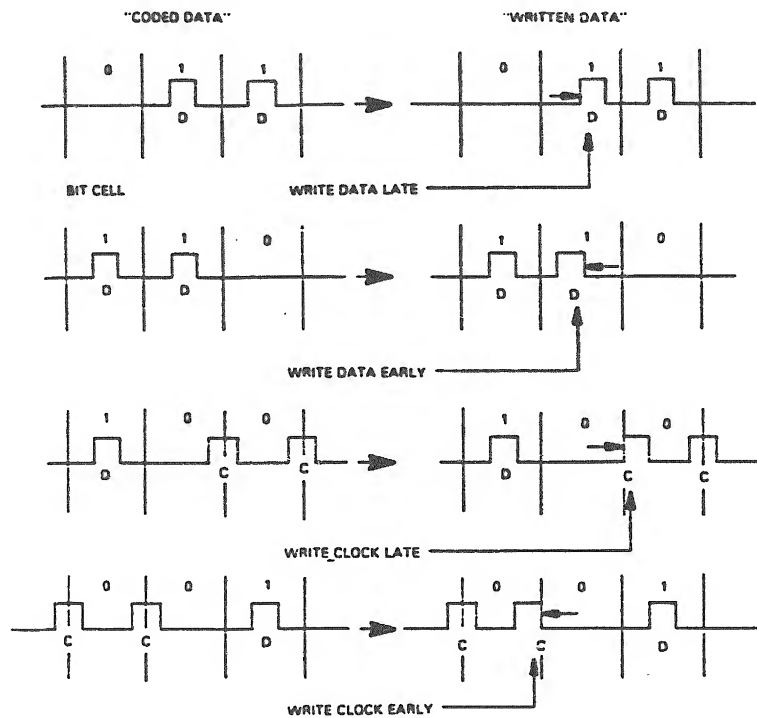


Figure 18, Write Precompensation Patterns